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CORR Insights®: Delayed Slipped Capital Femoral Epiphysis After Treatment of Femoral Neck Fracture in Children

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Where Are We Now?

Li and colleagues bring to our attention a rarely-reported occurrence following femoral neck fractures in the pediatric population. In the past 40 years, only five instances of slipped capital femoral

epiphysis (SCFE) following treatment of Delbert II (trancervical) and III (base of the femoral neck) hip fractures in children have been reported. Li and colleagues present two additional patients and review the sparse literature.

The ages of all reported patients range from 3.6 to 12 years. Prior to the present paper, all cases occurred in males. The two patients in the current study, a 12-year-old female and a 6-year-old female, both developed SCFE at 5 months and 9 months, respectively.

During the past four decades, treatment for femoral neck fracture has ranged from closed reduction with casting to surgical fixation. Fixation has varied from multiple screws to side plate and screws. Neither BMI nor health status information are included in the current paper. The authors assert that none of the patients had either

body habitus or endocrine disease, which are commonly associated with SCFE. Five of the seven patients developed either coxa vara or avascular necrosis prior to the slip, with one exception occurring 5 months to 15 months after the original injury. Only one patient had concomitant pubic rami fractures, suggesting significantly more initial force at time of injury. The authors concluded that SCFE can occur after femoral neck fracture in children, but the causes of this probably are multifactorial and are not well understood.

Where Do We Need To Go?

Most previous studies describe proximal femoral epiphyseal slips after hip fractures as being either mild or moderate, and occurring many months after the original injury [2–4, 6, 8]. The inquisitive surgeon might postulate that the incidence of SCFE following femoral neck fracture may be underappreciated, and therefore underreported. Understanding the pathophysiology of the proximal femoral epiphysis following

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injuries producing femoral neck fractures would enable earlier diagnosis of postfracture SCFE. Authors of the previously published case reports [2–4, 6, 8] suggested causes ranging from undetected initial epiphyseal plate fracture to increased shear stress secondary to either coxa vara or early weight bearing. There was also speculation that concomitant pelvic injury could predispose the patient to postinjury SCFE. Two recent anatomic studies [1, 7] have examined the relationship of pelvic anatomy to the occurrence of a slip. Gebhart and coauthors [1], with access to an osteologic collection, compared 14 pelvis with post-SCFE deformities to age-, sex-, and race-matched controls. They found no effect of acetabular retroversion, but did find smaller pelvic inclination in the SCFE pelvises. Conversely, Monazzam's group [7] used CT scans of the pelvis to compare 23 SCFE patients to 76 matched controls. Correcting for pelvic rotation, tilt and inclination; they found that the SCFE pelvis had superior acetabular retroversion and increased superolateral femoral head coverage. Further understanding of the effect of anatomic variation, as well as the effect of injury force on the proximal femoral epiphysis, is essential to predicting and preventing SCFE following femoral neck fracture.

Another generally accepted causative factor of SCFE is underlying endocrine dysfunction. While none of the case

reports in the literature had overt endocrine disease, the catabolic effects of major trauma usually produce an altered metabolic environment. Documenting these changes in children with femoral neck fractures may help delineate SCFE risk. A plethora of recent literature has postulated that a deficiency of vitamin D is occurring in the world population as a whole, involving developed and developing nations. This deficiency has been loosely associated with a myriad of musculoskeletal pathology. Two studies [5, 9] have reported on patients with SCFE associated with vitamin D deficiency. Skelley et al. [9] described SCFE occurring in a patient with known severe vitamin D deficiency. Mahuri and colleagues [5] measured 25-hydroxyvitamin D levels in SCFE patients and compared them to levels in matched controls. There was a statistically significant lower level of 25-hydroxyvitamin D in the SCFE group. Outlining factors in the metabolic environment of the epiphysis in these injuries would aid in better understanding and prevention.

While basic science studies on classic SCFE have been focused on the mechanical environment, pinpointing the exact cause has proven difficult. Williams et al. [11] used a proximal tibial model in sheep to study epiphyseal slip. Not only did they conclude that multiple variables affect epiphyseal ultimate strength, but their scanning electron microscope documented fractures in all epiphyseal zones

while also varying between samples. Most recently, Tank and colleagues [10] created a reproducible potential SCFE model in miniature swine. This could feasibly allow for studies of the effect of anatomic, mechanical, and metabolic factors on epiphyseal plates, therefore outlining the important criteria for post-femoral neck fracture SCFE.

How Do We Get There?

The concept of epiphyseal pathology associated with high-energy injuries to the proximal femur in the pediatric population is only theoretical. In order to better understand postfemoral neck SCFE, a multipronged approach is needed. Estimation of actual occurrence of this entity will require both surgeon awareness and multicenter studies from the Pediatric Orthopaedic Society of North America, the Orthopaedic Trauma Association, or the CDC Injury Prevention Unit, since the number of these fractures presenting to any one institution are small. Children sustaining multiple injuries are usually treated in specialized pediatric facilities, allowing for sophisticated metabolic and endocrine studies postinjury. These same facilities service large populations of children, allowing for population studies on dietary deficiencies. Continued basic science studies

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utilizing newer models may also provide needed information.

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